ECOS
Ecologists Educators and Schools: Partners in GK-12 Education

ECOS Inquiry

1. CONTRIBUTOR'S NAME: JOHNNY MACLEAN

2. NAME OF INQUIRY: ENERGY IN SUSPENSION

3. GOALS AND OBJECTIVES:

a. Inquiry Questions: How much energy is required to put clay, silt, sand, and gravel into suspension in water?

b. Ecological Theme(s): Effect of erosion on aquatic and riparian habitats

c. General Goal: Students will conduct an experiment to determine the energy required to put various particles such as sand, silt, and clay into suspension.

d. Specific Objectives: Measure the amount of energy required to suspend clay particles, silt particles, sand particles, and gravel particles in water. Compare the results with natural environments containing differing energies, such as mountain streams, big rivers, lakes, near shore environments, etc.

e. Grade Level: 4,5

f. Duration/Time Required:

→ Prep time: 30 minutes
→ Implementing Exercise During Class: 45 minutes
→ Assessment: 10 minutes

4. ECOLOGICAL AND SCIENCE CONTEXT:

Background: The number one pollutant of surface water is sediment. It transports pollutants and pathogens that affect the recreational value and the aesthetics of our waterways. Suspended particles cloud the water and screen out sunlight which impacts water quality by degrading the habitat for aquatic organisms, plants and fish. It also promotes the growth of weeds and algae. Neighborhood flooding and further erosion is produced when storm water drainage channels become clogged with sediment. In addition, sedimentation decreases the capacity of reservoirs to hold water and restricts infiltration of moisture into our wells and ground water storage. Understanding sediment transport connects earth processes to ecological processes by relating erosion to aquatic and riparian habitats.

5. MOTIVATION AND INCENTIVE FOR LEARNING:

Inquiry is done outside. Students design their own experiment (hopefully). Students use hoses, running water, and real sediment.

6. VOCABULARY (definitions from www.wikipedia.com):

- Clay—minerals that are typically less than 2 μm (micrometers) in diameter.
- Erosion—the displacement of solids (soil, mud, rock and other particles) by the agents of wind, water or ice, by downward or down-slope movement in response to gravity or by living organisms (in the case of bioerosion).
- Gravel—any loose rock that is at least two millimeters in its largest dimension (about 1/12 of an inch), and no more than 75 millimeters (about 3 inches).
- Sand—a naturally occurring, finely divided rock, comprising particles or granules ranging in size from 0.0625 (or 1/16) to 2 millimeters.
- Sediment—any particulate matter that can be transported by fluid flow and which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water or other liquid.

- Silt—particles below 0.0625 mm down to 0.004 mm in size.
- Suspension—the transport of sediments in rivers and oceans. Particles that are suspended remain suspended so long as energy (provided in the form of a current) is applied to the system. The amount of energy determines the maximum size of particle that can be suspended. In the absence of additional energy (agitation), all particles down to colloidal size will eventually settle out into a distinct phase.

7. SAFETY INFORMATION:

Take care to provide a safe environment for the use of water. Beware of using water in cold weather. Make clear rules regarding use of hoses and buckets.

8. MATERIALS LIST (including any handouts or transparency masters):

Water faucets
Hoses
Buckets (4 buckets per group of ~4 students)
Gravel (enough for each group to have one bucket 25% filled with gravel)
Sand (same)
Silt (same)
Clay (same)
Large spoons for stirring
Data sheet (attached)
Optional: flumes from Hellgate High School (thanks to Dave Oberbillig)

9. METHODS/PROCEDURE FOR STUDENTS:

a. Pre-investigation work: Teacher introduces the concepts of erosion, sediment, suspension, and the effects of erosion on habitats. Teacher leads class in a discussion of how to measure the energy required to put different types of sediment into suspension. Students design an experiment using the materials provided to answer the question: How much energy is required to put clay, silt, sand, and gravel into suspension in water?

b. Investigation work:

1) What evidence (data, samples) do students collect? Students (in groups of 4 or so) design their own experiment, but they will collect some sort of data regarding the force of the water resulting from stirring (vigorous, medium, or calm) that is necessary to agitate each kind of sediment into suspension (the sediment should be at rest under water in the bottom of a bucket).

2) How do students present the evidence (data)? Students present their data on the data sheet (attached).

3) What conclusions are drawn from the evidence students collect? Students conclude the relative (and possibly quantitative) energy requirements to suspend different types of sediment.

10. ASSESSMENT:

Teacher will monitor experiment designs and will review data sheets. Once the groups have completed their experiments, the class will reconvene and discuss results and ecological implications.

11. EXTENSION IDEAS:

With Hellgate High School's flumes, students could measure more accurately the amount of force necessary to suspend particles.

It could be possible to observe a stream bed at different times of the year and to discuss how spring flooding causes cloudy, fast-moving water compared to autumn's low streams. This

could lead into more discussion on how local ecosystems change during the course of the year. Students could also investigate erosion rates in big flat rivers compared to small steep rivers.

12. SCALABILITY

This could be scaled to higher levels by adding more quantitative measurements and increasing the discussion of ecological impacts.

13. REFERENCES:

www.wikipedia.com

14. LIST OF EXPERTS AND CONSULTANTS

Marc Hendrix—sedimentary geology professor at University of Montana

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT:

ENERGY IN SUSPENSION

DATA SHEET

Names of Group Members _____

1. How did you measure the energy required to put the gravel, sand, silt, and clay into suspension?

2. What were your results?

	Gravel	Sand	Silt	Clay
Energy on 1st try				
Energy on 2nd try				
Energy on 3rd try				
Average *(add the 3 together and divide by 3)*				

3. How much energy is required to put gravel, sand, silt, and clay into suspension in water?